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TITLE OF THE INVENTION
INFORMATION STORAGE MEDIUM AND INFORMATION
RECORDING/REPRODUCING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

5 This application is based upon and claims the
benefit of priority from the prior Japanese Patent
Application No. 2000-387665 filed December 20, 2000,
the entire contents of which are incorporated herein by
reference.

10 BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to information
storage media such as package media (compact disk (CD),
digital versatile disk (DVD), and the like), and an
15 information recording/reproducing apparatus. The
present invention relates particularly to a technique
which can prevent an illicit action such as an illicit
copy of user data which is recorded in the package
media and whose copyright is protected.

20 2. Description of the Related Art

For example, in a field of DVD video, contents
information (user data) is enciphered and recorded in a
disk in many cases. Moreover, key information for
deciphering the information is recorded in a specified
25 position of the disk.

When the contents information is reproduced in a
DVD video system, the key information recorded in the

specified position on the disk is reproduced by a reproduction apparatus. The reproduction apparatus decodes the enciphered contents information using the reproduced key information.

5 In a conventional technique, the key information and the contents information have the same modulation method and have an equal channel bit length. Therefore, as a problem, even when the position on the disk with the key information recorded therein is not known, an
10 illicit copy is enabled by wholly copying (disk copy) all information on the disk to another medium.

BRIEF SUMMARY OF THE INVENTION

To solve the problem, according to an aspect of the present invention, there are provided an
15 information storage medium including an illicit use preventing information by which an illicit use (reproduction/use) can be prevented even with copying (copy into the disk or a memory) of whole information on a disk or whole transmission information, and
20 information storage/reproduction method and apparatus.

In an embodiment of the present invention, a modulation method differs between key information, copy control information, or copy associated information/ cryptography associated information, and contents
25 information (user data information), or a channel bit length also differs therebetween.

That is, a modulation system or a channel bit

length is changed between the key information, copy control information, or copy associated information/ cryptography associated information, and the contents information (user data information).

5 Moreover, in an information reproduction apparatus in the present embodiment, reproduction of information having different modulation systems and channel bit lengths is enabled. On the other hand, an information recording/reproducing apparatus is constituted such
10 that only information having one type of modulation system and channel bit length with respect to the user data can be recorded into the information storage medium.

 Additional objects and advantages of the invention
15 will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the instrumentalities and
20 combinations particularly pointed out hereinafter.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

 The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention, and together
25 with the general description given above and the detailed description of the embodiments given below, serve to explain the principles of the invention.

FIG. 1 is an explanatory view showing one embodiment of a storage medium according to the present invention.

FIG. 2 is an explanatory view showing a constitution of a decoder according to the present invention.

FIG. 3 is a diagram showing a modulation system of a signal form according to the present invention.

FIG. 4 is a constitution explanatory view showing a signal extracting portion of a reproduction apparatus according to the present invention.

FIG. 5 is a constitution explanatory view showing another embodiment of the present invention.

FIG. 6 is a constitution explanatory view of a recording system in a storage/reproduction apparatus according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Embodiments of the present invention will be described hereinafter with reference to the drawings.

FIG. 1 shows one embodiment of an information storage medium of the present invention. Reference numeral 3 denotes an information storage medium for use, for example, in a DVD video system. User data recording regions 11, 12, and a cryptograph associated information or distinction associated information recording region 13 are serially (alternately) disposed on the same track on the information storage medium 3.

End mark information 23, 24 are recorded in respective ends of the user data recording regions 11, 12, and the cryptograph associated information or distinction associated information recording region 13.

5 This facilitates a boundary distinction between the respective recording regions. Moreover, variable frequency oscillators (VFO) 27, 28 as signals for synchronization and synchronous signals for distinguishing an end of data Sync 31, 32 are disposed
10 in tops of the respective recording regions 11, 13, 12. The top of the recording region 11 is not shown in the drawing.

Enciphered audio video (AV) contents information and/or management information (i.e., enciphered
15 information 52) are recorded in user data regions 21, 22 in the user data recording regions 11, 12. Even when the enciphered information 52 is reproduced by a reproduction apparatus, the information cannot be deciphered as it is. The management information is
20 information referred to by the reproduction apparatus, when the AV contents information is reproduced.

Key information 51 for decoding (deciphering) the enciphered AV contents information is recorded in a cryptograph associated information or distinction
25 associated information region 37 in the cryptograph associated information or distinction associated information recording region 13.

Additionally, VOF and Sync also exist in the user data recording region 11, but are omitted in the drawing. Moreover, the end mark also exists in the user data recording region 11, but is omitted in the drawing.

The user data recording region, and the cryptograph associated information or distinction associated information recording region repeatedly arrive in a time direction (reproduction direction). Here, a content of the key information recorded in the cryptograph associated information or distinction associated information recording region 37 may differ each time or cyclically, or may be the same regarding one disk.

FIG. 2 shows a signal processor in the reproduction apparatus for reproducing the information of the information storage medium. The enciphered information 52 is inputted into a decoder 102 via an enciphered information taking section 101, and the key information 51 is inputted into a decoder 102 via a key information register 103. Thereby, plain raw information 54 is obtained from the decoder 102, and derived from a raw information output section 104.

The key information demodulated by a demodulator (83 of FIG. 4) described later is stored in the key information register 103. The enciphered information demodulated by the demodulator (84 of FIG. 4) described

later is stored in the enciphered information taking section 101.

Here, turning back to FIG. 1, a characteristic of a storage signal will be described. In the present embodiment, a large characteristic lies in that a modulation method and channel bit length of the data recorded in the user data regions 21, 22 and cryptograph associated information or distinction associated information region 37 are varied.

Particularly the channel bit length of the information of the cryptograph associated information or distinction associated information region 37 is set to be shorter than the channel bit length in the user data regions 21, 22. Furthermore, both the channel bit lengths are set in a relation of non-integer multiple.

If the channel bit length of the information of the cryptograph associated information or distinction associated information region 37 is n -times (n is an integer value) the channel bit length of the information of the user data regions 21, 22, the information of the cryptograph associated information or distinction associated information region 37 can be recorded with one type of recording circuit for recording the user data regions 21, 22 with an additionally writable or rewritable information recording/reproducing apparatus. In this case, an object of the present embodiment cannot be achieved.

Therefore, in the present embodiment, the relation of non-integer multiple is set.

FIG. 1 shows a state of a pit arrangement P52 of the cryptograph associated information or distinction associated information region 37, and a state of a
5 signal S52 corresponding to the pit arrangement P52. In comparison, a state of a pit arrangement P51 of the user data region, and a state of a signal S51 corresponding to the pit arrangement P51 are shown.
10 The channel bit lengths have a relation of non-integer multiple.

Moreover, in the embodiment of FIG. 1, the key information is recorded in the cryptograph associated information or distinction associated information
15 region 37. However, the present invention is not limited to this embodiment, and includes the following techniques.

That is, (a) a medium is an additionally writable or rewritable information storage medium. Moreover,
20 the copy control information is recorded in the cryptograph associated information or distinction associated information region 37, and indicates information of "copy prohibited". In this case, a reproduction apparatus side can use the copy control
25 information as information by which any one of "prohibition of decipherment (outputting the enciphered information as it is)", "prohibition of reproduction",

and "prohibition of output" is set. Furthermore, (b) type distinction information of the information storage medium may be recorded in the cryptograph associated information or distinction associated information region 37. In this case, it is judged on the reproduction apparatus side that the medium to be reproduced is an information storage medium for exclusive use in reproduction, and then only important contents information is decoded and outputted. However, when other storage media are judged, the type distinction information can be used as information for setting either "prohibition of reproduction" or "prohibition of output".

The modulation method and channel bit length of the data recorded in the user data regions 21, 22 and cryptograph associated information or distinction associated information region 37 will be described with reference to FIG. 3. An 8/16 modulation is employed as the modulation system with respect to the data of the cryptograph associated information or distinction associated information region 37, and 8 bits of original information 61 before the modulation (see character b of FIG. 3) are converted to 16 bits (character c of FIG. 3). On the other hand, a (1.7 modulation) is employed with respect to the data of the user data region 12, and 8 bits of the original information 61 before the modulation (see character b

of FIG. 3) are converted to 12 bits (see character a of FIG. 3).

As described above, according to the method of the present invention, a bit number after conversion of the original information differs with the cryptograph associated information or distinction associated information 13 and user data 12. Therefore, even when the channel bit length of the original information 61 before the modulation is the same, the channel bit length after the modulation differs in both the regions (user data regions 21, 22 and cryptograph associated information or distinction associated information region 37).

The information reproduction apparatus for reproducing the information storage medium shown in FIG. 1 or an information reproduction circuit in the information recording/reproducing apparatus will be described with reference to FIG. 4. A very high frequency clock is outputted in an output of a voltage control oscillator (VCO) 74 which constitutes a phase synchronization loop circuit. When the information of the user data recording region 11 or 12 is reproduced, an output signal of a 1/3 frequency divider 76 is passed through a switch 77 and inputted into a reference clock output section 85, so that a reference clock α is formed. On the other hand, when the information of the cryptograph associated information

or distinction associated information recording region 13 is reproduced, an output signal of a 1/2 frequency divider 75 is passed through the switch 77 and inputted into the reference clock output section 85, so that the
5 reference clock α is formed.

An input signal from an input circuit 71 read from the disk is binarized by a binarizing circuit 78. An output of the binarizing circuit 78 is inputted into a data pattern distinguisher 80. In the data pattern
10 distinguisher 80, the reference clock α is used to reproduce data pattern. The reproduced data pattern information is inputted into an end mark detector 81. The end mark detector 81 detects the end marks 23, 24 from the data pattern and gives a detection signal to
15 the switch 77 and a switch 82. Thereby, the switch 77 is changed so that the frequency of the reference clock α fits the next channel bit length.

The reference clock α is used as a sampling clock of the binarizing circuit 78 and data pattern
20 distinguisher 80. A binarized signal outputted from the binarizing circuit 78 is inputted into an information processing circuit 79. In the information processing circuit 79, the synchronous signal is removed, and a frame is extracted. The extracted frame
25 (modulated signal) is inputted into a demodulator 83 or 84 via the switch 82. The demodulator 83 decodes the cryptograph associated information or the distinction

associated information, that is, performs 16/8
demodulation. Moreover, the demodulator 84 demodulates
the contents information. The switch 82 selects the
demodulator 83 or 84 based on a switch control signal
5 from the end mark detector 81. When the information of
the user data recording region 11 or 12 is reproduced,
the demodulator 84 is selected. When the information
of the cryptograph associated information or
distinction associated information recording region 13
10 is reproduced, the demodulator 83 is selected.

When the information of the cryptograph associated
information or distinction associated information
recording region 13 and user data recording regions 11,
12 are reproduced, the frequency of the reference clock
15 α is changed in accordance with each information. This
is a large characteristic of the information
reproduction circuit.

The information storage medium 3 has been
described as a medium for exclusive use in reproduction
20 with reference to FIGS. 1 to 4. The present invention
is also applicable to the additionally writable or
rewritable information storage medium as another
embodiment.

FIG. 5 shows an example in which the present
25 invention is applied to the additionally writable or
rewritable information storage medium 3. According to
a user's setting, a recording apparatus records the

information, when a recording mark string P1 is formed in an additionally writable/rewritable information storage region 42.

On the other hand, a read-in region 41 and a read-out region 43 exist in an innermost peripheral portion and an outermost peripheral portion of the information storage medium 3, respectively. The information is recorded in the form of a pit string P2 beforehand in the region, and cannot be rewritten. A cryptograph associated information or distinction associated information region 38 exists in the read-in region 41 or the read-out region 43. Key information or identification information 55 is recorded in the region. The key information or identification information 55 is used to decode enciphered information 52 recorded in a user information recording region 46. Also in this case, as shown in FIG. 3, the modulation system or the channel bit length of the information of the cryptograph associated information or distinction associated information region 38 and user information recording region 46 is set to differ.

Also in the present embodiment, when the reproduction processor decodes the information, the circuits of FIGS. 4 and 2 described above are applied.

FIG. 6 shows a circuit in the information recording/reproducing apparatus which handles the additionally writable or rewritable information storage

medium 3. A wobble 91 exists along a track in the additionally writable or rewritable information storage medium 3. A reproduction signal optically read and converted to an electric signal is inputted into a wobble detection circuit 92. The wobble detection circuit 92 filters and extracts a wobble signal, and supplies the signal to a binarizing circuit 93. A binarized signal outputted from the binarizing circuit 93 is inputted into a frequency comparator 94 and phase comparator 95. An oscillation signal of a voltage control oscillator (VCO) 96 is frequency-divided by a frequency divider 97 and given to the frequency comparator 94 and phase comparator 95. A frequency error signal obtained from the frequency comparator 94 and a phase error signal obtained from the phase comparator 95 are used as an oscillation frequency control signal of the VCO 96. Thereby, an oscillation output of the VCO 96 forms a signal synchronized with a frequency and phase of the wobble signal, and is supplied to a reference clock circuit. A reference clock β generated here is supplied to a laser drive circuit 99. Moreover, the reference clock β is modulated based on a recording signal supplied from a recording signal generation circuit 98, and forms a laser light, and the laser light is outputted.

As shown in FIG. 6, different from a reproduction circuit system of FIG. 4, only the reference clock β is

generated in a recording circuit system. Only one type of frequency exists in the reference clock β . The frequency is matched with a frequency for recording/reproducing the recording mark string P1 in the additionally writable/rewritable information storage region 42, and does not form a frequency corresponding to the channel bit length of the cryptograph associated information or distinction associated information region 38.

Therefore, in the recording circuit system in the information recording/reproducing apparatus which handles the additionally writable or rewritable information storage medium 3, it is impossible to record the information of the cryptograph associated information or distinction associated information region 38.

As described above, this embodiment is applied to the information storage medium in which first information including at least one type of information from copy associated information, cryptography associated information, and identification information, and second information different from the first information and used by a user are recorded. Here, a first reference length (channel bit length) is defined in the information storage medium (region) with the first information recorded therein, and reproduction signal information regarding the first information is

recorded at an interval which is integer times as long
as the first reference length. Moreover, a second
reference length (channel bit length) is defined in the
information storage medium (region) with the second
5 information recorded therein, and the reproduction
signal information regarding the second information is
recorded at an interval which is integer times as long
as the second reference length. Furthermore, the first
reference length and the second reference length are
10 set to be different from each other.

Moreover, in the recording/reproducing apparatus
with respect to the additionally writable or rewritable
information storage medium, only a function for
recording the information in accordance with the second
15 channel bit length is disposed in an additionally
writable or rewritable information recording region.
As a result, it is impossible to record the information
recorded with the first channel bit length in the
additionally writable or rewritable information
20 recording region.

Moreover, according to the present invention,
there can be provided an information reproduction
apparatus which reproduces the first information with
respect to the information storage medium, and performs
25 at least one processing of reproduction control of the
second information, decipherment of the second
information, and output control of the second

information based on a content of the first information.

Thereby, medium identification information and copy control information can be applied as the first information which cannot be recorded by the recording/ reproducing apparatus with respect to the additionally
5 writable or rewritable information storage medium.

Moreover, reproduction of the second information, or output of the second information can be prohibited based on the content of the first information.

10 Furthermore, since the first information cannot be copied, high reliability can be secured with respect to the first information.

Moreover, the key information for decipherment can be applied as the first information which cannot be
15 recorded by the recording/reproducing apparatus with respect to the additionally writable or rewritable information storage medium. This can strongly prevent copy prohibited information from being further copied to another medium or region. That is, even if the
20 first information is forcibly copied to the recording region in the additionally writable or rewritable information storage medium, the key information cannot accurately be copied because of different channel bit lengths. Therefore, in an illicit action, wrong key
25 information is copied. Even if the key information is used to reproduce the second information in the reproduction apparatus, accurate decoding (decipherment

processing) cannot be performed.

Additionally, the present invention is not limited to the aforementioned embodiments. In the above description, the disk is an object as the information
5 storage medium, but of course the present invention can also be applied to a signal medium transmitted by radio or via a cabled transmission path. Moreover, the present invention can also be applied to an apparatus for transmitting the signal and a receiving apparatus
10 and method. Considering signal transmitting and receiving apparatuses, there are provided an apparatus for transmitting an information string shown in FIGS. 1 and 5 onto the transmission path (FIGS. 2, 4), or an apparatus for taking the information string from the
15 transmission path (FIGS. 2, 4).

Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details and representative embodiments
20 shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general invention concept as defined by the appended claims and their equivalents.